Original Research Article

IDENTIFICATION OF SIGATOKA LEAF SPOT DISEASE IN BANANA USING CONVOLUTIONAL NEURAL NETWORK (CNN)

ABSTRACT

AIM: Rapid and Early identification of the cause of the disease enables prompt selection of the protection method and reduces the yield loss. Lag in disease diagnosis reduces the crop output and increases the cost of cultivation. To overcome this problem, deep learning techniques are used to identify Sigatoka leaf spot disease in bananas through image detection. CNN is a dependable method to identify the disease at the initial stages to help farmers.

Place and Duration of Study:
Agricultural College and Research Institute, Tamil Nadu agricultural university, Coimbatore.
Duration of the experiment was three months.

METHODOLOGY: Image of diseased leaves and healthy leaves were collected from the different areas of Pollachi and Coimbatore, Tamil Nadu, India. Variations in colors were removed and the quality of the image was enhanced to increase the accuracy. The image dataset comprised of a total of 2008 images of banana Sigatoka leaf spot and healthy banana leaves for differentiation and evaluation. Initial stage of training includes loading of the image data for training, determining the learning rate, running the optimizer, and compiling the training convolution model. The model's accuracy is assessed in the last step, saving the accuracy and loss occurred during training.

RESULT: The experiment result shows that disease detection accuracy of the intended model is 96.41% . It gives higher accuracy and improved performance.

Keywords: - Accuracy, Banana, CNN, Dataset, Deep learning, Diagnosis, Sigatoka, Training

1. INTRODUCTION

Banana(*Musa sp*.) is one of the most popular and oldest fruits in the world. It significantly contributes to food security. It serves as a staple food, cash crop and means of livelihood to several people in the world. Banana is an elongated, curved with soft interior flesh and rind - covered fruit which is produced by herbaceous plant. It is a member of the Musaceae family (genus *Musa*). Banana plants are gigantic herbs as they do not have woody stems but they are often mistaken as trees. Bananas feature a false stem, known as pseudostem, that is made of overlapping leaf sheaths. "Banana blossom", "banana flower", or "banana heart" are all names of the inflorescence of the banana plant.

Banana heart develop in banana fruits are also described as "leathery berry". Banana fruits are grouped in clusters(10 to 20) called hands. Bananas include a lot of fibre, potassium, vitamin B6, vitamin C, folate, and other phytonutrients and antioxidants. Banana is aboriginal to South East Asia. Tropical areas have extensive cultivation of it. The two wild species from which most of the edible bananas evolved are – *Musa acuminata* and *Musa balbisiana.* Sigatoka leaf spot in banana is caused by the fungus *Mycosphaerella spp.*, it results in yield loss up to 80%. The disease lowers the leaf's potential for photosynthetic activity through necrotic leaf lesions.(Milsha George *et al., 2021).* The area under banana cultivation is roughly 5.6 million hectares, and an estimated 113,212,452 tones of bananas are produced annually Worldwide. India is the leading producer of bananas in the world with a total estimated area under banana production is 961 thousand hectares (2022). Every year, 29,124,000 tonnes of bananas are produced in India. India's top three banana-producing states are Andhra Pradesh, Maharashtra and Gujarat respectively. Andhra Pradesh accounts for 16.27 % of the total production of bananas in India.

Several cultivars of banana are highly susceptible to the disease like Sigatoka leaf spot, Bunchy top, Panama wilt, Anthracnose, Freckle spots, Moko wilt which are the principal cause of loss of yield in bananas. Before implementing any crop protection approach in the field, a foliar disease must be correctly diagnosed. Ineffective diagnosis ultimately reduce agricultural yield and raise plant protection costs(Kalpana M. *et al.,2022).*

Due to rapid growth in population, there is an increase in demand for food supplies. Crops are vulnerable to disease attacks due to pathogens which cause drastic loss in yield. Disease should be identified at early stages so that loss could be minimized. Identification of disease manually is time taking, tedious and chances of errors are very high(Orchi H *et al.*,2021).

Early and accurate Detection of disease in plants is very important in order to enhance productivity. Conventionally, the cause of abnormalities in plants due to several factors is identified manually. It is relatively time taking, error prone and an expensive process. To overcome these problems, research is being conducted to use image processing techniques for identification of plant disease (Lawrence C.Ngugi *et al.,* 2020). The diagnosis of various plant diseases is one of the many farming aspects where computerization in agriculture has made tremendous strides. Plant disease identification is one of the major challenges in agriculture and has a considerable impact on crop production. Machine learning

models may be utilised to enhance early detection of disease in plants. (Jubin Dipakkumar Kothari*.,* 2018).

New technologies and advanced farming techniques are needed to overcome the problem of the increasing demand for food. Artificial intelligence can be used to tackle this problem, it will help to improve the quality of crops and help in management of crops and to face future challenges (Paras M. Khandelwal *et* al., 2019). Artificial intelligence is being used frequently across various sectors. The application of AI allows for a thorough analysis of the issue and aids in the development of remedies. Early disease identification in plants is possible with the aid of Artificial Intelligence (Gyan Singh Sujawata *et al.,*2021).

In the field of image processing, convolution neural networks have contributed to some notable advancement. Numerous apps have been developed for the purpose of image processing to identify the disease in crops (Justine Boulent *et al.,*2019).

Multiple diseases have the potential to drastically impair crop yield, thereby jeopardising food security. Therefore, it is critical and vital to accurately detect plant disease. Traditional techniques, such as visual observation and laboratory tests, have many drawbacks, like time taking and error prone. Convolutional neural networks, are now widely used to diagnose plant diseases (Jinzhu Lu *et al.,*2021)

AI can be utilized thoroughly to analyze the issue and assist in presenting solutions. Artificial intelligence used to increase the precision, effectiveness and identification of Sigatoka diseases in Banana. Considering the engagement, the work has been put together for identification of Sigatoka leaf spot disease in banana using the technology of CNN.

2. **RESOURCES AND METHODS USED TO CONDUCT THE RESEARCH.**

This section lists the resources and procedures utilised in the study under headings like Collection of Data labeling, architecture of CNN, and labeling of data.

2.1 COLLECTION OF DATA

Surveys were carried out in Banana fields present in the area of pollachi and Coimbatore, Tamil Nadu, India. Two dataset were compiled – image of Sigatoka leaf spot in Banana (*Mycosphaerella sp.*) and image of healthy leaves of banana plants. Data was collected during the morning hours to get better clarity of symptoms. The total number of images collected were. 2008, out of which healthy leaf images were 1005 and leaves with Sigatoka leaf spots were 1003.

In Sigatoka disease symptoms include pale yellow streaks (1 to 2 mm) that eventually combine to create dark, rusty brown to black patches encircled by a yellow halo are the first signs of the condition. The spots combine to produce enormous, erratic swaths of desiccated tissue. This disease's defining characteristics include rapid drying, leaf defoliation, smaller bunch sizes, and irregular ripening of fruit. We collected pictures of healthy banana plants which showed no symptoms of any disease.

Fig 1:Image of Sigatoka leaf spot

Fig 2:Healthy leaves of Banana

2.2 ARCHITECTURE OF CNN

Deep learning is a subset of artificial intelligence. For automatic learning to take place it requires a massive volume of data such as images, videos or texts. Deep learning helps the machine to emulate human behavior. Information is processed by the neurons present in layers, deeper the layers of neuron more complex data can be learnt by the model. Deep Learning neural network design known as a Convolutional Neural Network (CNN) is frequently employed in computer vision. A computer's ability to comprehend and interpret visual data is made possible by the field of artificial intelligence known as computer vision. A feed-forward neural network technique known as a convolutional neural network (CNN) makes use of layers called convolutional layers. The convolution operator, which entails moving a

condensed collection of weights across the layer's input, carried out by a convolutional layer (LeCun *et.al.,1998).*

There are many layers in a convolutional neural network, including the input layer, the convolutional layer, the pooling layer, and the fully connected layers. In order to extract features from the input image, the convolutional layer applies filters. The final prediction is made by the fully connected layer after the image has been downscaled by the pooling layer to minimize computation time.

During the experiment raw data is identified and instructive labels are added. The categorization label is the one that has the highest chance of being utilized (completely linked layer). After completing the first training phase, load the training images, configure the learning rate, run the optimizer and creates the training convolution model.

The final step is to evaluate the accuracy of the model and save the accuracy. Adam optimizer and RMSprop algorithm are used to dynamically change the learning rate during training. Learning rate LR is equal to 1e-3.

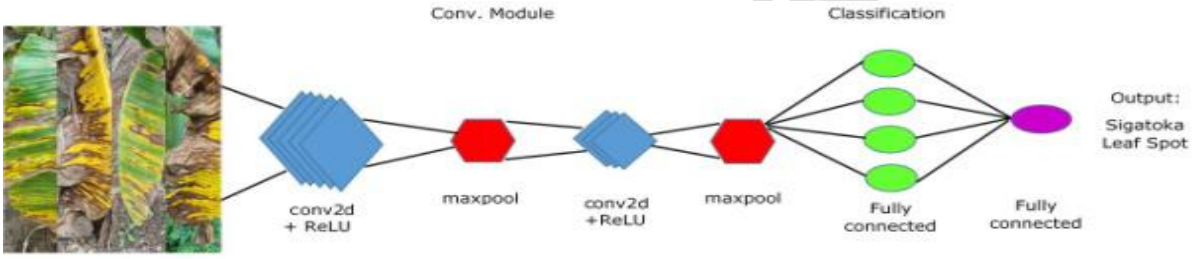

Fig 3: CNN architecture for banana disease diagnosis.

2.3 Training

Images of banana Sigatoka leaf spot were collected from the field, images were processed and enhanced images were used for training and testing the CNN model. 80% of healthy and diseased leaf images were taken as training and 20% of healthy and diseased images were used for testing. Total number of healthy leaf images - 1005 and leaf with Sigatoka leaf spots - 1003. Total Training images were 1608 and test images were 400. Python programming was used to implement the training and testing of banana foliar disease model. It was used to classify images of banana leaves into healthy and diseased leaves showing the symptoms of sigatoka leaf spot.

3. RESULT AND DISCUSSION

Experiment was carried out using Python programming; images were trained using iteration in order to improve the outcome. Iteration was carried out on image dataset of banana sigatoka leaf spot disease and healthy leaf of banana with 2008 samples.

The accuracy of training and verification improves gradually with iteration, accuracy tends to stabilize and achieves a satisfying level.

The result of experiment demonstrates that CNN has higher accuracy, with accuracy of disease identification in banana is 96.41 %. The suggested model has better performance than conventional image identification methods, requires fewer efforts and provides helps in early identification of sigatoka leaf spot in banana with healthy leaves.

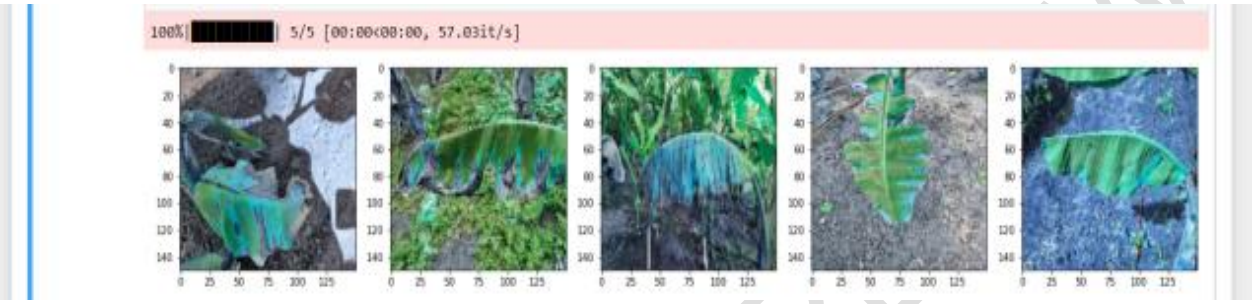

Fig : 4 Prediction of banana disease using CNN

4. CONCLUSION

Bananas are seriously afflicted by the disease known as Sigatoka leaf spot leaf spot. It is one of the most destructive foliar diseases that decimates wide regions of farms, drastically reducing fruit production. In Banana Sigatoka leaf spot can causes 80% loss in yield. This CNN based research was used for identification of Sigatoka leaf spot in banana. This model investigated the leaves showing symptoms of Sigatoka leaf spot and healthy leaves with no symptoms of the foliar disease and put forward technical specifications of the model, detailed picture sources and reported model overall accuracy. The detection of foliar diseases in crops is a progressive process, it will offer a workable way for farmers and researchers to precisely diagnose the disease and to take necessary preventive measures. In addition, the suggested approach provides a time-saving and early detection means for the identification of Sigatoka leaf spot in banana and leading to use of advanced technologies in agriculture. This CNN based experiment provides the accuracy of 96.41% in identification of sigatoka leaf spot disease in Banana.

6. REFERENCE

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